

Life cycle assessment handbook—a guide for environmentally sustainable products by Mary Ann Curran (ed), ISBN: 978-1-118-09972-8, 640 pp, 2012

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The Life cycle assessment handbook presents over 600 pages of information about life cycle assessment provided by 47 authors from 10 countries. In spite of the many contributors, the book avoids the trap of the anthology with little coherence between the individual contributions and large gaps in the overall presentation. However, it is not a handbook in the traditional sense. As stated by the editor, Mary Ann Curran in the preface to the book, this is not a “how to” manual with step-by-step instructions for conducting an LCA. The editor had three specific stated goals with the book:

1. To be comprehensive, “... covering every possible facet of methodology and application”.
2. To let the experts and leaders in LCA tell—engaging recognized professionals from industry, academia and LCA consultants
3. To capture the latest advancements in LCA methodology and application in one place

All three goals have been achieved with the book, and it will be a useful reference tool for a wide audience including students in environmental studies, government policy makers, product designers and manufacturers, and environmental management professionals, i.e. anyone who wants to get introduced to a LCA approach and/or implement it in their organization.

The book is divided in four parts:

Part 1: Methodology and Current State of LCA Practice

Part 2: LCA Applications

Part 3: LCA Supports Decision Making and Sustainability

Part 4: Operationalizing LCA

It is the intention with the book that the reader reads the chapters from start to end as the later chapters build on the earlier, but at the same time to present the individual chapters as self-contained units. This has been well accomplished through enforcing a consistent structure on each chapter with an abstract, a summary or conclusion and a list of references.

Part 1 starts with a good recapitulation of the history of Life cycle costing (as the predecessor of LCA) and the development of the LCA field over four decades—from the conception in the 1970s and 1980s, over the standardization activities in the 1990s, and the elaboration and divergence of methodology developments in the 2000s, to our current decade, coined as the decade of Life Cycle Sustainability Assessment. The rest of Part 1 is dedicated to four chapters on the LCA methodology, with a dominant focus on the life cycle inventory (LCI) data and modelling and the life cycle impact assessment (LCIA) phase.

The chapter on inventory modelling takes a very practice-oriented and operational approach to the topic and targets many of the well-known challenges of the systems modelling in the LCI. I particularly liked the pedagogical presentation of the problems of multi-output processes and their solutions in practice. A chapter on sourcing of inventory data also gives hands-on advice on the modelling of inventory data for unit processes and gives a comprehensive overview of national and industry organization databases with LCI data around the world. This overview is nicely supplemented with non-LCA-related sources of technical information relevant to the LCA practitioner, who wishes to create process inventory data for use in product system modelling. In the sourcing of LCI data, the use of input–output-based approaches is briefly mentioned. However, the advantages and problems associated

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with these approaches are not discussed anywhere in the chapter or in the rest of the book, which would have been a useful guidance to the reader, considering their current extent of application.

The ensuing chapter on Life cycle impact assessment gives the reader an up-to-date overview of existing LCIA methods and their differences and similarities based on recent surveys of the field. It concludes with a presentation of the main current focus points of methodology development for LCIA and the trends that can be observed here.

The presentation of the LCA methodology concludes with a chapter on the LCA software that has become indispensable for the performance of LCA in practice. This chapter gives a nice overview of the existing types of LCA software and what I found to be an interesting outlook on the trends and possible future developments of the LCA software market from one of the developers of the dominating large scale open source LCA software.

The handbook is not devised as a textbook, but taken together, the chapters of Part 1 offer an introduction to LCA methodology that may be useful to the university student in a course on industrial ecology or sustainable engineering, or to the engineer or manager in industry or government who speculates on what it involves to perform an LCA. Part 1 also serves as the methodological foundation for the application examples given in the second part of the book.

Part 2 devotes 11 chapters to a presentation of the methodological challenges and the main findings from applying LCA in a number of different fields, including the following:

- Agri-food industry with an interesting discussion of the challenges in- and consequences of the choice of functional unit in food LCA studies and other issues of specific importance to food industry such as fertilizer and pesticide emission modelling, and assessment of land use and water use impacts.
- Waste management systems, presenting key assumptions that can significantly impact the results of waste LCAs and summarizing the typical findings, largely confirming the traditional waste hierarchy. The literature list in this chapter completely lacks the extensive European work done on LCA of waste management systems.
- Waste management and optimization of the life cycle of preservative-treated timber, giving preference to incineration with heat recovery over landfilling.
- Food waste and packaging, with many concrete recommendations for reduction of food waste all along the value chain and with a particular focus on the trade-offs around the extent of food packaging based on results from a large Norwegian research project.
- Mining and minerals processing, pointing out gaps and constraints, notably the modelling of ecotoxicity and resource depletion impacts in the LCIA. It would also

have been relevant to discuss the allocation problem inherent in all mining where ores produce more than one metal, and the uncertainties involved in using economic allocation here.

- Buildings, offering a nice introduction and overview of databases, tools and resources, and the dominating assessment and certification systems (from a North American perspective) and introducing the international standards and codes for the buildings field.
- Chemical industry, on the integration of the use of LCA with the principles of green chemistry and engineering, using LCA to evaluate and prioritize the central principles like chemical hazard reduction, atom economy, energy footprint and preference to renewable feedstock.

There are also chapters on integration of LCA with exergy analysis and accounting for ecosystem services, while other chapters focus less on the performance of LCA and more on the use of LCA results in product innovation or in life cycle management and decision support in the supply chain management. In the latter, the case of a large multinational enterprise like Procter & Gamble is developed with interesting insights in how life cycle thinking can be used to push the supply chain in a more sustainable direction.

There is some variation in the depth and comprehensiveness of the individual chapters and there are chapters that are weak in their literature foundation. There is also some repetition of fundamental methodological elements from LCA in a few of the application chapters—but generally no inconsistencies. In accordance with the stated ambition of the editor, these methodological recurrences in Part 2 allow the chapters to be read as self-contained texts and at the same time makes all chapters well suited for consecutive cover to cover reading. Altogether, Part 2 has a wealth of application examples presented by experts within each of the represented fields, and offers inspiration and good advice to the LCA student or practitioner embarking on the fields.

It would have been relevant with a chapter on the Environmental Footprint guidelines (PEF and OEF) and their associated Product Category Rules, developed by the European Commission with a potential to become influential for many companies, not just in Europe. These guidelines were not finalized at the time of printing but the directive was in place and the guidelines were well under development, so some of the authors must have had knowledge about them. Nevertheless, this case illustrates that the development of a handbook on LCA is a moving target.

Part 3 broadens the scope of the book beyond mere LCA and moves on to investigate how LCA can be integrated with the economic and social dimensions of sustainability to provide a more comprehensive assessment also representing dynamic mechanisms. Separate chapters address the positioning of LCA relative to other assessment tools like risk assessment

and environmental impact assessment (exemplifying their use on a case study of municipal solid waste management in Vietnam) and the integration of multi criteria decision analysis (MCDA) tools in the valuation phase of LCA. A chapter on Social LCA takes us outside the environmental regime and presents the state of the art for assessment of social impacts in a life cycle perspective. This leads on to a presentation of the Life Cycle Sustainability Analysis where LCA is positioned in a larger framework with other assessment techniques that at the same time supports both a broadening of the spectrum of modelled indicators and the object of analysis beyond the product level, and a deepening of the analysis with increased sophistication and consideration of economic and behavioral mechanisms. Finally a chapter on environmental product claims gives a nice overview of the different types of ecolabels and other environmental product claims and exemplifies the discussion of environmental product declarations with Product Category Rules and EPDs for dairy products. The latter is accompanied by a very extensive annex (46 pages!) containing the PCRs for processed liquid milk and an EPD for a specific product.

Part 4 of the book offers an outlook towards making life cycle information operational in the decision processes of the different actors among companies, governments and consumers on the global scale. A chapter provides a good overview of the needs and perspectives for LCA capacity building

in developing countries. Based on an interesting analysis of the challenges (in terms of lack of local demand, LCA capacity and data), the chapter offers an operational roadmap with numerous ideas to effectively improve capacity building of LCA in developing countries. In the final chapter, one of the fathers of modern LCA, Jim Fava, draws on many years of experience as consultant to industry and governments and presents examples of important learnings that LCA has helped give us over the years as well as learnings that it could have given us, had it been applied at that time. He draws parallels to the adoption of quality and safety criteria in decision making in, e.g. product design and concludes that the trend is similar for inclusion of LCA information and that we need to support this trend by disseminating knowledge, building competences among LCA practitioners and making quality data and tools available.

My overall impression of the book is that of a rich source of LCA information offered by a large group of LCA experts in their respective fields. It is not a handbook in its narrow definition; however, the book has a very good and detailed index, which allows the reader to look up specific terms or topics and find them at multiple locations in the chapters (e.g. ‘Allocation’ has 33 indexed occurrences, ‘Critical (peer) review’ has 8), and this greatly increases its value as a reference for LCA students and practitioners.